MSFC-208

US Plans for the JEM-EUSO

Presented by Jim Adams

- **Optics Investigations**
- **Trigger Design**
- **Event Reconstruction**

Issues for the US proposal

- Low Technical Risk for Optics
  - We must demonstrate the capability to make the optics
- Concerns
  - Diffractive
    - We need to find someone who can make it
  - CYTOP
    - How to diamond turn it
    - Uniformity
    - Other maturity issues?
  - Other optics manufacturing issues
    - Surface roughness
    - Throughput
    - Scattered light from outside the field of view

Optics Investigations

- Lens Manufacturing
  - Manufacture two 1 meter lenses from PMMA
  - Test lenses in the UV to determine
    - Spot size versus field angle
    - Throughput versus field angle
- CYTOP Testing
  - Diamond turning tests
  - Refractive index uniformity tests
- Diffractive Testing

Lens Manufacturing

- Manufacture two lenses from PMMA
  - Diamond turn on the Moore machine
  - Post-polish to reduce surface roughness
- Manufacture a metering structure
  - Holds the lenses to create the optic for testing
- Test the optic
  - Use the AMOR facility
    - 2 meter uniform beam
    - ~350 nm

CYTOP Testing

- Diamond Turning
  - We have a limited amount of CYTOP
  - We were not successful in our first try
  - We are looking for advice
- Uniformity Testing
  - We plan to use a Fizeau interferometer
  - Use a tank with optically flat walls
  - Immerse CYTOP in index matching fluid

Diffractive Testing

- We can test a diffractive for JEM-EUSO
  - We understand that a diffractive can be manufactured in Japan
  - We have a design for a 10 cm f/5 diffractive lens with 1 meter focal length
  - If it can be manufactured in Japan, we will test it at UAH

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Diffractive test details

- Diffractive Design
  - Design wavelength: 0.357 microns
  - Maximum depth of cut: 0.695 microns
  - Total number of facets = 3500
  - Mean facet width = 14 microns
  - Maximum facet width = 845 microns
  - Minimum facet width = 7 microns
- Matching smooth plano-convex lens
  - Radius of curvature 513.58 mm
- Determine the diffractive efficiency by comparison

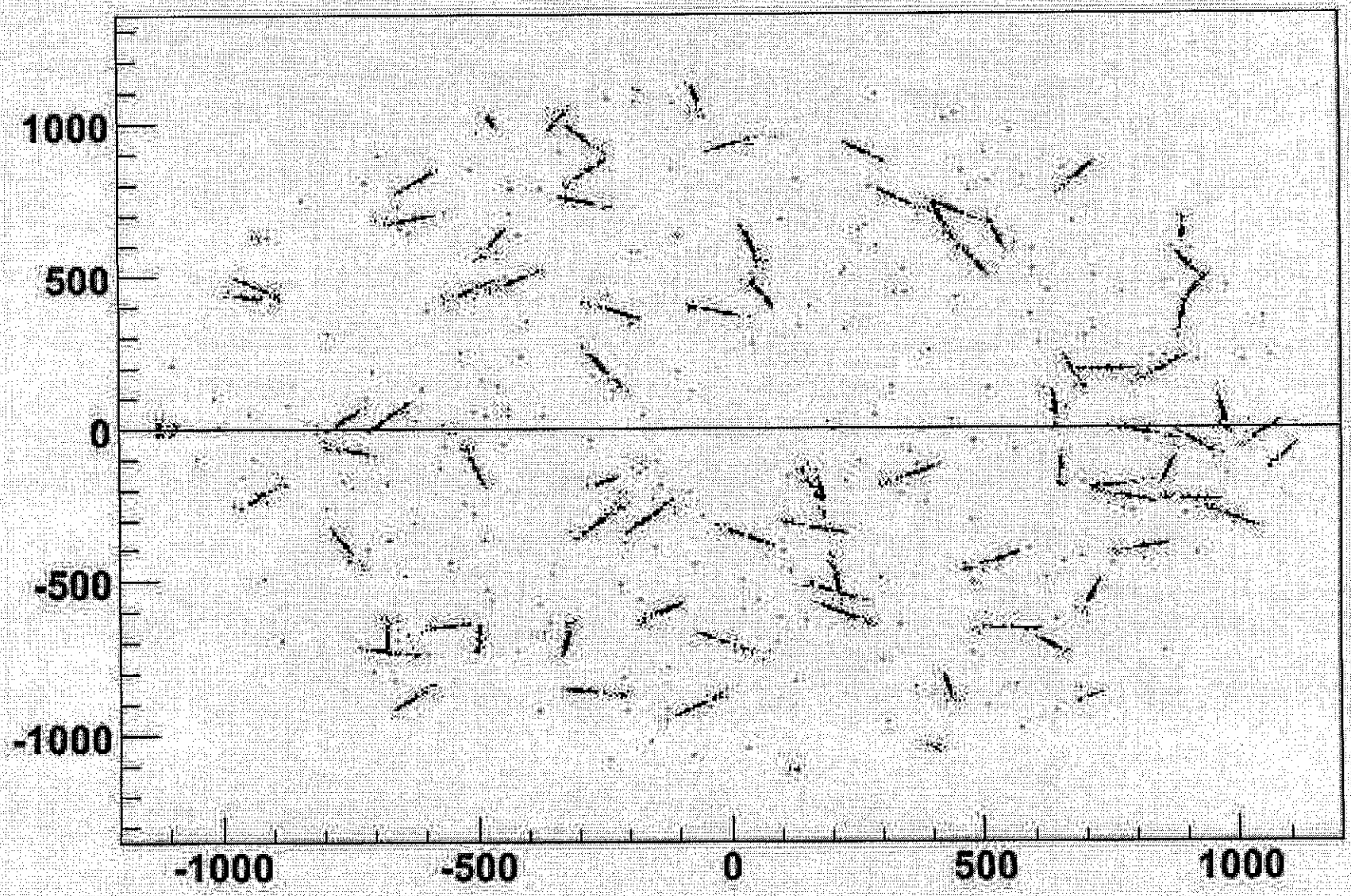
Trigger Design

- Space Sciences Lab (UCB) trigger
  - Designed by Crawford and Judd
- Multilayer trigger
  - 1st layer trigger (rate ~ 1 kHz)
    - Overlay frames from successive gate timing units
    - Shift successive frames to account for
      - Shifting image of non-vertical tracks
    - Look for good signal/noise
  - 2nd layer trigger (<0.1 Hz)
    - Use pattern recognition to recognize CR tracks

Event Reconstruction

- Use ESAF simulations
  - Investigate trigger threshold
    - Use ESAF simulated events
    - Determine trigger efficiency
  - Investigate event reconstruction threshold
    - Examine ESAF simulated events
    - To find the lowest energy event that can be reconstructed to find its energy and arrival direction
  - Can JEM-EUSO be done without a diffractive?

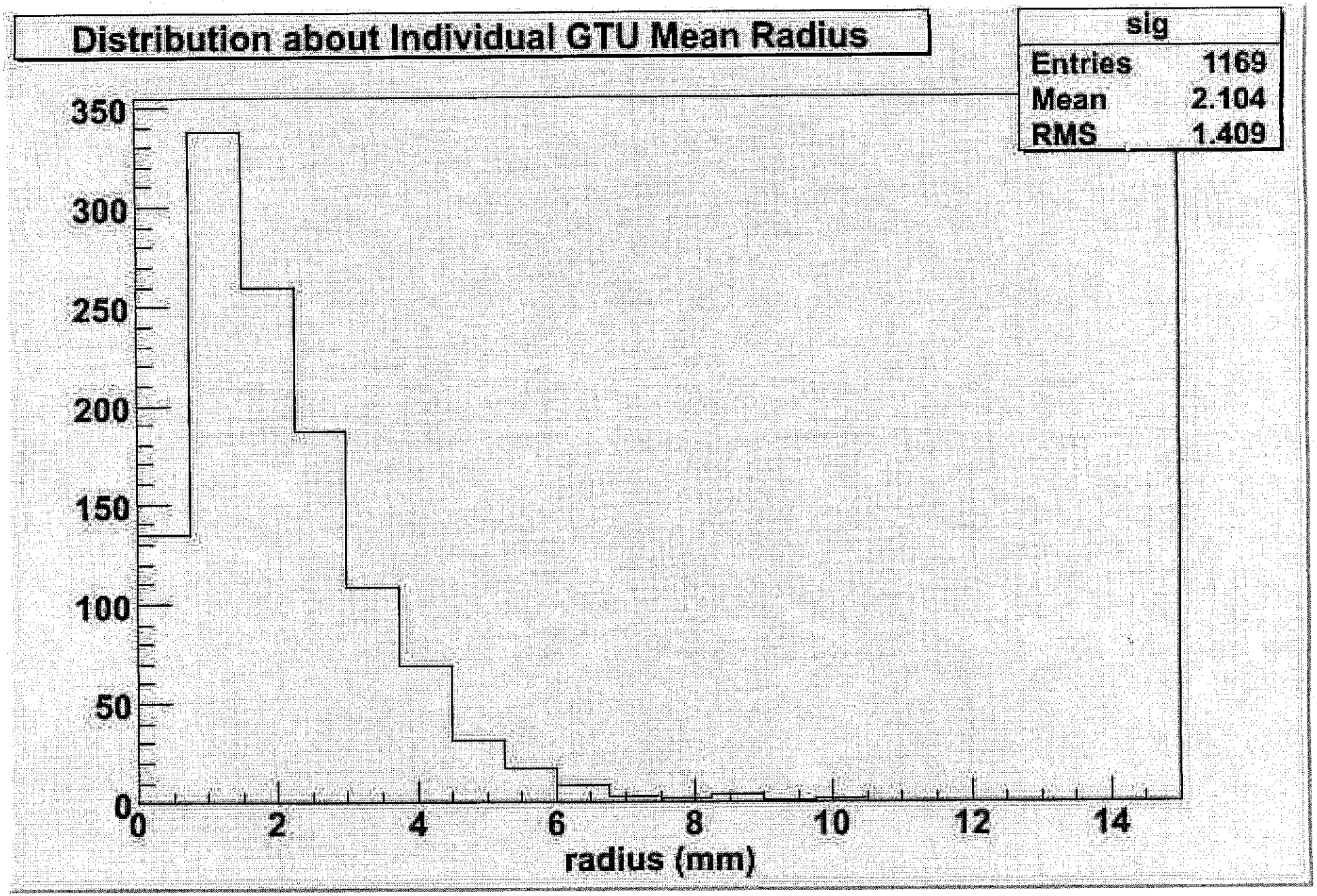
100 events simulated at 60° and 10^{20} ev



Point Spread Function

- 100 events were simulated at 60° and 10^{20} ev.
- Each photon is tagged with its' GTU.
- For GTUs that contained more than 10 photons
  - The mean radius vector for the GTU was calculated
    - Subtracted this from the radius vector for each photon.
    - Giving the distance spread about the GTU center
    - This distance is plotted in the next figure.

Note: The event moves across the focal plane during the time of one GTU broadening the distribution. At 60° the movement is estimated to be about 2.5 mm per GTU.


Distribution about Individual GTU Mean Radius
sig
Entries 1169
Mean 2.104
RMS 1.409
350
300
250
200
150
100
50
0
0
2
4
6
8
10
12
14
radius (mm)

Discussion Points

How can we coordinate our investigations for JEM-EUSO?

- Cytop Testing
  - Can we work with you to find out how to machine CYTOP?
- Can you manufacture a diffractive for us to test?
- How can we coordinate simulation efforts better?